Art. X.—*Further Notes on Australian Hydroids.—II.*

By W. M. BALE, F.R.M.S.

(With Plates XII., XIII.)

[Read 10th July, 1913.]

The present paper is in continuation of my last communication to the Society, which was read in April, 1893. During the somewhat long interval but little has been done in Australia towards advancing our knowledge of its hydroid fauna, the only contributions which I am aware of being those of Messrs. Bartlett, Mulder, and Trebilcock, in the "Geelong Naturalist." A number of new and interesting forms were made known in these papers, mostly among the smaller species, and principally from collections made in or near Port Phillip; and since this is the case with a locality which has perhaps been better searched than any other in the States, it may readily be imagined what a wealth of information remains to be gathered by future investigators along our less-explored shores.

A quantity of hydroid material which was dredged by the "Thetis" in 1898 was sent to Mr. Jas. Ritchie, of the Royal Scottish Museum, Edinburgh, and the results were published by the Australian Museum in one of its Memoirs nearly two years since. In this paper a number of new forms are described, and a good deal is added to our knowledge of already-known species.

A number of hydroids dredged from time to time by the Commonwealth trawler "Endeavour" have been placed in my hands for examination, among them being some new and striking forms obtained from the little-explored region of the Great Australian Bight. These form the subject of a Report, which was completed some months since, and which it is expected will shortly be published. A small lot of material since received contains several additional forms new to our fauna, which I hope to report upon at a future date.

Though no other works have appeared specially devoted to the Australian Hydroida, many of our species have been described in accounts of collections made in other parts of the world during recent years, and the number of forms known to be common to Australia and other regions has been considerably augmented, while numerous changes in nomenclature have found more or less accept-

ance. Many specific names formerly adopted by me have been ranked as synonyms of older species, following on the examination of museum types of former observers, whose descriptions were so incorrect or inadequate that it had been impossible to identify the species which they were intended to indicate. This is especially the case with the hydroids described by Lamarck and Lamouroux, of whose descriptions a great many were quite valueless, so that the species remained unidentified for nearly a century, till Dr. Billard recorded the results of his examination of the type specimens. The same observer has also examined the British Museum collections, and finds a number of the species (Australian and other) described by Allman in the "Challenger" Report, and elsewhere, to be identical with previously-known forms (in addition to those which I had, in former papers, noted as synonyms of some of Busk's and Kirchenpauer's species). I may remark in passing that a similar revision of Kirchenpauer's types would be very serviceable. His accounts of some of the species leave much to be desired, and in two or three cases where the types have been examined, they prove to be such as could not be recognised from the descriptions and figures.

A few of the species dealt with in the following pages have been treated by recent observers as synonyms of older species, from which they are really distinct, and to clear up their affinities I have described them more fully, though in fact, some of the original descriptions were inconsistent with the synonymy assigned to them. Two of Busk's species, which have only been identified in recent years, are here fully described, and one or two changes are made in specific names, for various reasons. In view of the unfortunate vehicle of publication chosen by the Geelong observers (the "Geelong Naturalist" being issued in such limited numbers that scarcely any copies were available for purchase), I proposed re-describing such of the new species, as I had, through the courtesy of Mr. Mulder, obtained specimens of, but have had to postpone doing so to a possible future opportunity.

I cannot let pass this occasion (the first which has presented itself) of expressing my hearty thanks to those observers who have favoured me with their publications. These are:—Miss Laura Thornely, of Liverpool; Dr. R. Kirkpatrick, of the British Museum; Mr. Jas. Ritchie, of Edinburgh; Dr. E. T. Browne, of Berkhampstead; Dr. A. Billard, of Paris; Professor M. Bedot, of Geneva; Professor G. M. R. Levinsen and Mr. P. Kramp, of Copenhagen; Dr. Cl. Hartlaub, of Heligoland; Dr. Elof Jäderholm, of Sweden; Dr. E. Stechow, of Munich; A. K. Linko, of St. Petersburg; Dr. G. Mark-

tanner-Turneretscher, of Graz, Austria; Professor C. C. Nutting, of Iowa City; Dr. C. McLean Fraser, of British Columbia; Professor S. F. Clarke, of Williamstown, Massachusetts; Dr. A. G. Mayer, of Cambridge, Massachusetts; Dr. E. Warren, of Natal; Mr. Inaba, of Kyoto; Mr. H. Farquhar, of Wellington; Mr. Thos. Whitelegge, of Sydney; Mr. J. F. Mulder, of Geelong; Professor R. von Lendenfeld.

I have also to gratefully acknowledge the assistance rendered to me in other ways, especially by Professor Nutting, Dr. Stechow, Dr. Hartlaub, Dr. Kirkpatrick, Mr. Ritchie, Dr. Billard and Mr. Mulder, who have either sent me specimens, or compared my specimens with types, or otherwise assisted me in the endeavour to settle the affinities of doubtful forms.

Hydra viridis Linné.

Hydra viridis, Linné, Faun. Suec., 1746, p. 367; id., Syst. Nat. I., 1767, p. 1320; Johnston, Brit. Zooph., 1847, p. 121, fig. 28; Hincks, Brit. Hydr. Zooph., 1868, p. 312, fig. 40; Bedot, Zool. Anzeig, xxxix., 1912, p. 603.

Hydra viridissima, Pallas, Elenchus, 1766, p. 31; Brauer, Zool. Anzeig, xxxiii., 1908, p. 790.

H. viridis has not hitherto been included in lists of the Australian hydroids, but it is found abundantly, in company with the brown hydra, in ponds bordering the Yarra near Melbourne; and its occurrence in those localities has been noticed in the "Victorian Naturalist" on several occasions.

Pennaria wilsoni, n. nom.

Halocordyle australis, Bale, Proc. Roy. Soc. Victoria, N.S., vi., 1893, p. 94.

It is now generally recognised that the genus *Halocordyle* is not really distinct from *Pennaria*, to which genus our *H. australis* must accordingly be relegated. In order to avoid confusion with *P. australis* Bale (although that species is now considered by some observers to be only a variety of *P. cavolinii*), it seems advisable to re-name the present form, which was dredged in Port Phillip by the late Mr. J. Bracebridge Wilson.

All the species hitherto referred to *Pennaria* appear to be identical in habit, the stem giving off two series of alternate branches, which are both in the same plane, or nearly so, while the short polypiferous ramuli form a single series along the distal side of the branches. In *P. wilsoni* (at least in the mounted specimens), the

branches are all directed to one side, and so appear at first sight to be uniserial; in reality, however, they originate in two planes about 90 deg. apart, but are then directed so decidedly forward that when mounted they fall to the same side, and seem to have a secund disposition. A more important distinction, however, is the arrangement of the ultimate ramules, which in *P. wilsoni* are biserial, and like the branches are in two planes about 90 deg. from each other. They are, as a rule, alternate, but there are sometimes irregularities in their disposition, such as two occurring in succession on the same side. This arrangement, and the very much more pronounced annulation, distinguish the polypidom from that of *P. australis*.

The only specimens I have seen consisted of two mounted pieces, and Mr. Wilson was unable to say what the size of the original specimen had been, or to give any further details of the ramification.

Hebella scandens (Bale.) (Plate XII., Fig. 10).

Lafoëa scandens, Bale, Proc. Lin. Soc. N.S.W., 2nd Ser., iii., 1888, p. 758, pl. xiii., figs. 16-19.

Hebella scandens, Marktanner-Turneretscher, Ann. d. k. k. Naturh. Hofmus., v., 1890, p. 214, pl. iii., fig. 16; Farquhar, Trans. N.Z. Inst., xxviii., 1896, p. 460; Campenhausen, Zool. Inst. d. Univ. Jena, 1897, p. 307 (?); Hartlaub, Zool. Jahrb., Suppl. vi., iii., 1905, p. 587; Warren, Ann. Nat. Gov't. Mus., i., 1908, p. 341, fig. 21; Levinsen, Vidensk. Medd. f. d. naturh. Foren, 64, 1913, p. 285.

Lictorella scandens, Borradaile, Fauna and Geogr. of the Mald. and Laccad. Archipel. ii., 1905, p. 840.

Hebella cylindrica (in part), Pictet, Rev. suisse de Zool., i., 1893, p. 41, pl. ii., fig. 36; Versluys, Mém. de la Soc. Zool. de France, xii., 1899, p. 31.

Lafoëa calcarata (in part), Billard, Bull. du Mus. d'Hist. nat., 1904, p. 481; id., Exp. Sci. du Trav. et du Talisman, viii., 1907, p. 174.

Hebella calcarata (in part), Billard, Arch. de Zool. Exp. et Gén., 4 sér., vii., 1907, p. 339; Ritchie, Proc. Zool. Soc. Lond., 1910, p. 810; id., Mem. Austr. Mus., iv., 1911, p. 816.

Hebella contorta, Marktanner-Turneretscher, Ann. d. k. k. naturh. Hofmus., v., 1890, p. 215, pl. iii., fig. 17 a, b; Campenhausen, Zool. Inst. d. Univ. Jena, 1897, p. 307; Levinsen, Vid. Medd. f. d. naturh. Foren, 64, 1913, p. 285, pl. v., figs. 16, 17.

(?) Not *Lafoëa calcarata*, Agassiz, Mem. Mus. Comp. Zool. Harvard, i. 1865, p. 122, fig. 190; Hargitt, N. Amer. Nat., xxxv., 1901, p. 387, fig. 24.

(?) Not *Hebella calcarata*, Nutting, Bull. U.S. Fish. Comm., xix., 1901, p. 353, 378, figs. 56, 94.

Not *Lafoëa cylindrica*, von Lendenfeld, Proc. Lin. Soc. N.S.W., ix., 1884, p. 912, pl. xl., figs. 4, 5.

This is one of a series of closely-allied forms, the specific relationship of which is more or less doubtful. Pictet first classed together the *Lafoëa cylindrica* of von Lendenfeld, *Hebella contorta* and *H. cylindrata* of Marktanner-Turneretscher, and—somewhat doubtfully—*Lafoëa scandens*. Billard added to the list *Lafoëa calcarata*, Agassiz, of which he regards all the others as synonyms.

Pictet claims that he finds in Amboyna specimens, in the same colony, hydrothecae coinciding exactly with the descriptions of the three species which he unites (other than *H. contorta*), and his only reason for doubt as to the identity of *H. scandens* arises from an apparent difference in the gonophores. Regarding *H. contorta* he remarks, referring to the flexure of the hydrothecae, "Nous ne pensons pas cependant qu'il y ait lieu d'en faire une espèce distincte, car ce n'est évidemment qu'un phénomène pathologique provenant, soit d'une mauvaise méthode de conservation, soit d'une autre cause inconnue." The assumption that the bent form of the hydrothecae is due to bad preservation is perfectly groundless; it is the usual and normal condition of this hydroid, which, however, does not seem to me to differ more than varietally from *H. scandens*, especially since Levinsen has shown that its gonangium is exactly similar to that of the latter species.

My experience differs from that of Pictet in regard to the trophosome. I have observed many colonies of *H. scandens*, and several of *H. contorta*, but have not found any great variation in the hydrothecae. And Pictet does not explain how he was able to satisfy himself that the characters of *L. cylindrica* are such as to justify its association with the other forms; Von Lendenfeld's statement that his species has the hydrothecae "large as in *L. parasitica*" seems to forbid such association, and there is reason to believe that it is identical with a form to be described further on, whose size is such as to take it far out of the range of the species or variety observed by Pictet.

The gonosome of Pictet's specimens is described thus:—"Gonothèques allongés, recourbés en forme de corne d'abondance, à parois lisses, renfermant trois bourgeons medusoïdes en forme de cloche,

disposés sur une rangée." According to the figure the aperture is circular and entire.

The gonangium of *H. scandens* and *H. contorta* is not recurved cornucopia-fashion, and its wall is not smooth, but feebly annulated; its aperture when mature is divided into several shallow emarginations, each with its opercular flap. As Levinsen justly remarks, "The gonothecae of *H. contorta* seem to be very different from those of *H. calcarata* and *H. cylindrica*, figured by Agassiz and Pictet."

As to the gonophores themselves, Pictet says, "Dans cette espèce [*H. scandens*] en effet, les gonothèques contiendraient deux gonophores renfermant chacun trois à quatre œufs et surmontés d'un gros blastostyle en forme de trompette, tandis que sur les exemplaires récoltés à Amboine, les gonothèques renferment trois bourgeons médusoïdes en forme de cloche très facilement reconnaissables."

He goes on to suggest that the apparent blastostyle of *H. scandens* is really the first medusoid bud, an erroneous interpretation having been given to badly-preserved specimens. The suggestion as to the blastostyle is somewhat extraordinary, as it is difficult to imagine how the structure which I have figured (as it exists) could be confused with a gonophore; nevertheless, I have no doubt that Pictet is correct in supposing that the gonophores are medusoid, and it is quite possible that three may be produced, though not all at one time, as in the form which Pictet has figured. In the few specimens which seemed to be complete there appeared first the large trumpet-shaped blastostyle, then the first gonophore, which, however, was not in a condition to enable its structure to be made out satisfactorily, and below this the second bud, an ovate body in a much more rudimentary stage of development. In one or two instances there was at the base of the gonotheca a slight enlargement, which may perhaps have been the earliest rudiment of a third medusoid, but its minute size and the presence in each case of foreign matter obscuring it made its character a matter of uncertainty. If a gonophore, its development must be very late, for even in a case where the first had escaped, and the second seemed mature, it was still apparently no further advanced.

On the whole I conclude that Pictet's own account of both the gonotheca and its contents, if correct, furnishes strong evidence against the identity of his specimens with *H. scandens*, and reasons will be given for believing *H. cylindrica* to be an entirely different species. I have not seen *H. cylindrata*, and therefore offer no opinion regarding it. As to *H. calcarata*, it may possibly be the

same as *H. scandens*, but the descriptions certainly do not establish their identity. A. Agassiz says that the gonangia are gigantic as compared with the hydrothecae, which is decidedly not the case with *H. scandens;* their form also is different. The more advanced medusa is said to fill the cavity of the gonangium almost entirely, and to be from 1-20th to 1-16th of an inch long when it escapes. In *H. scandens* the largest medusa measured in each case, when apparently about mature, slightly under 1-40th of an inch, and never occupied more than a small proportion of the gonangium. According to Agassiz, Nutting, and Hargitt the hydrothecae of *H. calcarata* are very strongly curved at the base (Nutting says doubly curved), and are generally borne in pairs, neither of which conditions obtain in *H. scandens.* The free medusa of *H. calcarata* is well known, but that of *H. scandens* has not been observed, nor has that of Pictet's specimens.

Hebella cylindrica (Von Lendenfeld). (Plate XII., Fig. 11.)

Lafoëa cylindrica, Von Lendenfeld, Proc. Lin. Soc. N.S.W. ix., 1884, p. 912, pl. xl., figs. 4, 5.

Not Hebella cylindrica, Pictet, Rev. Suisse de Zool., i., 1893, p. 41, pl. ii., fig. 36; Versluys, Mém. Soc. Zool. de France, xii., 1899, p. 31; Weltner, Hydr. von Amboina u. Thursday Id., 1900, p. 586; Jäderholm, Arkiv. f. Zool., k. svenska Vetenskapsakad, i., 1903, p. 274.

All the records of *H. cylindrica* since the date of Pictet's paper on the Hydroids of the Bay of Amboina, refer to small forms like *H. scandens*, which were, by that author, associated under the name of *H. cylindrica.* The form which I now, with little hesitation, refer to that species is of far larger size than any of these, but it certainly agrees better with Von Lendenfeld's figure and description, neither of which, however, directly indicates the size of the specimens. The drawing is said to be made with "A objective and C ocular," without even intimating whose lenses are referred to; if Zeiss', the combination quoted would give a magnification of over 100, and the figure, if on that scale, would represent a form with the hydrothecae less than .25 mm. in length, or much too small for even *H. scandens.* As Von. Lendenfeld expressly mentions that the hydrothecae, as well as the hydranths, are "large as in *L. parasitica*," it is evident that the reference to the lenses employed does not indicate the scale on which the figure was drawn.

The specimen now in question has hydrothecae about 1 mm. in length, or slightly larger than those of *H. parasitica*, and more than double the average of *H. scandens*, and stout in proportion. It agrees perfectly with Von Lendenfeld's figure, except that the rim of the hydrotheca is a trifle less everted. This rim is doubled in one case, but the two rims are extremely close together. It is growing on *Synthecium alternans*, as shown in the figure, and for comparison I give a figure on the same scale of *S. cylindricum* with *H. scandens* growing on it. The hydrothecae of the two species of *Synthecium* are of about the same size, and it will be seen that the comparatively gigantic hydrothecae of *H. cylindrica* surpass in size those of the *Synthecium* as much as the latter exceed those of *H. scandens*.

The specimen of *S. alternans* on which this *Hebella* was found was a small piece (apparently a pinna) sent to me by Dr. Kirkpatrick from the "Challenger" collection. I at first contemplated describing the *Hebella* as new, but on comparing it with Von Lendenfeld's account of *H. cylindrica*, found it so closely similar as to suggest the strong probability of their being the same. This conclusion is arrived at from the figure of the supporting hydroid, as well as from that of the *Hebella* itself. Von Lendenfeld says that the species grows on Sertularians, but mentions no particular species. The figure agrees, however, very fairly with *Synthecium alternans*, and not with any other Sertularian which I am acquainted with; moreover, the relative sizes of the Sertularian and the *Hebella* are much the same as those of *S. alternans* and the species under consideration; there is every probability therefore that these two are the same forms that Von Lendenfeld has figured.

The species differs from *H. scandens* (at least so far as this specimen is concerned), in the absence of the chitinous "floor" of the hydrotheca. There is an unmistakable "floor," on which the flattened base of the hydranth is supported, but it appears to be purely membranous, and not an ingrowth of the perisarc, as in *H. scandens*.

Sertularia loculosa Bale. (Plate XII., Figs. 7, 8.)

Sertularia loculosa, Bale, Aust. Hydr. Zooph., 1884, p. 91 (part), pl. iv., figs. 5, 6, pl. xix., fig. 9; Warren, Ann. Natal Gov't. Mus., i., 1908, p. 306, fig. 8, pl. xlviii., fig. 37.

Sertularia turbinata, Billard, Ann. Sci. Nat., 9 sér., xi., 1910, p. 19 (in part); (?) Ritchie, Proc. Zool. Soc. Lond., 1910, p. 821.

Not *Sertularia loculosa*, Busk. Vide *Sertularia turbinata* (Lamouroux), p. 124.

Not *Dynamena turbinata*, Lamouroux, Vide p. 124.

Hydrocaulus about half an inch in height, often continued into a stolon, unbranched. Hydrothecal internodes mostly a little shorter than the width across the hydrothecae, one or two at the summit often much elongated, nodes sometimes single and transverse, often double, with the lower transverse and the upper conspicuously oblique and slender, the latter occurring at irregular intervals.

Hydrothecae opposite, a pair on each internode, divergent, but with the lower portions in contact or approximate in front, separated behind; mostly short and squat in form, with a distinct oblique fold or ridge crossing them about the middle; aperture looking outwards and upwards, with two lateral teeth, generally blunt and rounded, but in some specimens more pointed, a third tooth often developed above.

Gonothecae ovate, truncate, not compressed, with several strong annular ridges; summit with a wide operculate opening; borne on the lower part of the shoots.

Colour, brown, pale to very dark.

Hab.—Queenscliff; Port Phillip; Portland (Mr. Maplestone); Natal Coast, common (Warren).

Under the name of *S. loculosa* Busk, I included in the "Catalogue of the Australian Hydroid Zoophytes," along with Busk's type, two or three forms which I had observed in collections from Port Phillip. One of these, of pinnate habit, is probably identical with *S. inflata* (Versluys), and, with that species, is referred in the present paper to the *Dynamena marginata* of Kirchenpauer. The other varieties differ considerably from Busk's, and I have long been doubtful whether they should not be separated, though reluctant to propose a new name on grounds perhaps insufficient.

In 1909 Billard announced, as a result of his examination of Lamouroux' types, that the *D. turbinata* of that author is the same as Busk's *S. loculosa*, corresponding in all respects, as Dr. Billard informs me, with Busk's drawing. I now propose, while accepting the original name, *S. turbinata*, for Busk's species, to separate the common short-celled form, and to retain for it the name of *S. loculosa*, under which it is already generally known. The grounds of separation will be briefly stated.

In *S. loculosa*, as restricted, the hydrothecae are short and squat in form, slightly divergent throughout, so that the two constituting

a pair are in contact in front only at the lower part, and the bases of the hydrothecae, as well as the transverse ridges, run obliquely to the axis of the hydrocaulus. In *S. turbinata* the hydrothecae are more erect in the lower part, the main divergence being above the ridge, which is at right angles to the axis of the hydrocaulus. The vertical ridge where the two hydrothecae meet is not continued downward in *S. loculosa* as it often is in *S. turbinata*. The mouth in *S. loculosa* is upward-directed, with distinct lateral teeth, while in the other form it looks rather downward, and the lateral teeth or lobes are but feebly developed.

The internodes in *S. turbinata* are separated by simple nodes, transverse or very slightly oblique, which are usually very close above the hydrothecae. In *S. loculosa* similar nodes exist, but in addition to and above them there are found at irregular intervals oblique nodes, in which the base of the upper internode runs down into a point in front, while the top of the lower one is produced upward into a similar point at the back. Such double joints may occur between most of the hydrothecal internodes on a shoot, or there may be only one or two of them, and the straight ones vary a good deal in distinctness. The effect is that the short section of hydrocaulus between them constitutes a separate internode, as Warren justly describes it, and the condition is exactly similar to that of many species of *Plumularia*, in which the short intermediate internode is separated from the hydrothecal internode above by a long oblique joint, and from that below by a straight transverse one, often less distinct. The only difference is that in *Plumularia* the short intermediate internodes are of regular occurrence, while here they are irregular.

In both *S. loculosa* and *S. turbinata* one or two internodes—usually only one—at the summit of a shoot may be very much elongated below the hydrothecae, but the hydrothecae themselves are not longer than those found elsewhere. In some specimens of *S. loculosa* ("Catalogue," pl. iv., fig. 6) the hydrothecae are less squat than usual, with the teeth less obtuse, a variation which approximates them to *S. marginata*, but not to *S. turbinata*.

Warren finds *S. loculosa* common on the Natal coast, and his detailed description leaves no doubt of its identity with the common Australian form. Only in the gonangia is any difference indicated, the Natal form having from seven to nine annulations, while my specimens have only five. The difference may possibly be sexual; Warren's figured specimen was female, but he does not state whether the male was observed; my specimens were empty, and in only two of them have I seen the gonangia at all.

Billard has associated under the name of *S. turbinata* not only the two simple forms referred to above, but also the pinnate form described by Kirchenpauer as *Dynamena marginata*, and also known as *S. inflata* (Versluys), and by other names. This will be further referred to under *S. marginata*.

Sertularia turbinata (Lamouroux). (Plate XII., Fig. 6.)

Dynamena turbinata, Lamouroux, Hist. Polyp. Cor. Flex., 1816, p. 180; id., Encycl. Méth. ii., 1824, p. 290.

Sertularia turbinata, Lamarck, An. s. Vert., 2nd Ed. ii., 1836, p. 154; Bale, Aust. Hyd. Zooph., 1884, p. 96; Billard, C. R. Acad. d. Sci., cxlviii., 1909, p. 1064; id., Ann Sci. Nat. (9 ser.), ix., 1909, p. 322 (in part); Id. (9 sér.), xi., 1910, p. 19 (in part).

Sertularia loculosa, Busk, Voy. of Rattlesn. i., 1852, p. 393; Bale, Aust. Hydr. Zooph., 1884, p. 91 (part), pl. ix., fig. 12; Jäderholm, Ark. f. Zool., k. svenska Vetenskapsakad, i., 1903, p. 285.

Not *Sertularia loculosa* Bale. Vide p. 121.

Hydrocaulus about half an inch in height, often continued into a stolon, unbranched. Internodes mostly a little longer than the width across the hydrothecae, the proximal one shorter, one or two at the summit often much elongated; nodes transverse, mostly immediately above the hydrothecae.

Hydrothecae opposite, a pair on each internode, in contact in front for a considerable part of their length, separated behind; upper portion divergent almost horizontally, a distinct horizontal fold or ridge crossing them about the middle; the thickened vertical ridge marking their union in front often continued downward beyond the bases of the hydrothecae; aperture looking outwards and somewhat downwards, with two very indistinct lateral lobes.

Gonothecae not compressed, with five or six strong annular ridges, summit with a wide operculate opening; borne on the lower part of the shoots or on the hydrorhiza.

Colour, brown, often very dark.

Hab.—Bass Strait, 45 fathoms (Busk); Java Sea (Jäderholm); Paumben, India (?) (Jäderholm).

The characters which distinguish this—the original type of *S. loculosa*, Busk—from the short-celled form hitherto associated with it have been detailed under *S. loculosa*, and will be obvious on reference to the figures.

The precise form of the hydrotheca-margin is doubtful. In the best-preserved specimens there is an angle in the middle of the upper side, but no tooth, and the lower side is simply rounded, or with two lateral lobes scarcely indicated. But so delicate is the perisarc at the margin that the shape seems in all cases more or less altered. Even in the fresh specimens the condition seems to have been similar, as Busk described the aperture as irregular. In *S. loculosa* the perisarc is stouter, and there is even a distinctly thickened border to the aperture, but this is wanting in *S. turbinata*, at least in these specimens.

Whether the oblique nodes, which in *S. loculosa* are found in addition to the simple transverse ones, ever occur in *S. turbinata*, I cannot say. None exist in my specimens, which consisted altogether of about sixty internodes, and Jäderholm, whose specimens corresponded with Busk's figure, does not mention them.

The gonangia are similar to those of *S. loculosa*, with, according to Jäderholm, five or six annulations.

The species appears to be rare. I have seen no examples other than Busk's, though *S. loculosa* is quite common in the same locality (Bass Strait), and the only other record I have met with, besides Lamouroux', is that of Jäderholm. Possibly *S. loculosa* is a shallower-water form, and hence more often thrown on the beach.

In considering the validity of the distinction which I have drawn between these two forms it must be borne in mind that I have had only the one mounted colony of *S. turbinata* under examination. It remains for future investigation to determine the relationship between the two forms.

SERTULARIA MARGINATA (Kirchenpauer). (Plate XII., Fig. 9.)

Dynamena marginata, Kirchenpauer, Verh. d. K. L.-C., deutschen Akad. d. Naturf., xxxi., 1864, p. 13, figs. 8-8c.

Sertularia flosculus, D'Arcy W. Thompson, Ann. and Mag. N.H., Ser. 5, iii., 1879, p. 104, pl. xvii., figs. 2-2a.

Sertularia amplectens, Allman, Journ. Lin. Soc., Zool., xix., 1885, p. 141, pl. xvi., figs. 3, 4; Jäderholm, Bihang till. k. svenska Vet.-Akad., xxi., 1896, p. 13, pl. i., fig. 9.

Desmoscyphus gracilis, Allman, Chall. Rept., Part ii., 1888, p. 71, pl. xxxiv., figs. 2-2c.

Desmoscyphus inflatus, Versluys, Mém. Soc. Zool. de France, xii., 1899, p. 42, figs. 11-13.

Desmoscyphus brevicyathus, Versluys, Mém. Soc. Zool. de France, xii., 1899, p. 40, figs. 9-10.

Sertularia inflata, Jäderholm, Ark. f. Zool. k. svenska Vetenskapsakad. i., 1903, p. 286; Vanhöffen, Deutsche Südp.-Exp., 1901-3 xi., 1910, p. 321, f. 38; Stechow, Zool Jahrb., xxxii., 1912, p. 361.

Sertularia versluysi, Nutting, Amer. Hydr.—Sert., 1904, p. 53, pl. i., f. 4-9; Billard, Actes., Soc. Lin. Bord., lxi., 1906, p. 74; id., C. R. Acad. d. Sci., cxlviii., 1909, p. 194; id., Bull. Mus. Hist. Nat., xiii., 1907, p. 275; Congdon, Proc. Amer. Acad. Arts and Sci., xlii., 1907, p. 481; Ritchie, Proc. Zool. Soc. Lond., 1907, p. 505, fig. 144, pl. xxiv., fig. 2-6; Fraser, Bull. Bureau of Fisheries, xxx., 1912, p. 375, fig. 40.

Sertularia brevicyathus, Nutting, Amer. Hydr.—Sert., 1904, p. 60, pl. vi., figs. 1-2.

Sertularia turbinata, Billard, An. Sci. Nat., 9 sér., xi., 1910, p. 19 (in part).

Not *Dynamena turbinata*, Lamouroux, Hist. Polyp. Cor. Flex., 1816, p. 180; id., Encyc. Méth., ii., 1824, p. 290.

Not *Sertularia turbinata*, Lamarck, An. s. Vert., 2nd Ed., ii., 1836, p. 154.

Hydrophyton monosiphonic, pinnate (rarely simple) often under half an inch in height, but sometimes reaching two inches. Proximal portion of the stem without pinnae or hydrothecae. Pinnae alternate, each borne on a distinct process at the base of a stem-internode, which supports also an unpaired hydrotheca in the axil, and a pair of sub-alternate hydrothecae above. First internode of each pinna short, without hydrothecae, separated from the next internode by an oblique conspicuous joint, at which it readily separates; joint between the first internode and the cladophore straight, often less distinct or obsolete; nodes slender and oblique, or straighter, and less distinct.

Hydrothecae of the pinnae or simple shoots in pairs, opposite, mostly in contact in front, short and stout, with a slight oblique fold or ridge crossing them about the middle; aperture nearly vertical, with two large pointed triangular lateral teeth, and sometimes with a third smaller tooth above.

Gonothecae oblong, compressed and lenticular in transverse section (flattened behind and convex in front), with several distinct transverse annulations; the superior angles produced upwards into two large incurved horn-like processes; aperture narrow.

Colourless or brownish.

Hab.—Williamstown, Port Phillip.

I have in the main followed Billard in the synonymy of this species, adding, however, *S. brevicyathus*, and excluding the two unbranched forms, *S. loculosa* and *S. turbinata*, already treated of. The two latter forms, besides being always, so far as is known, unbranched, differ from the present in the form of the gonangia, which are rounded in section, with a wide operculum covering the whole of the summit, while those of the pinnate form are plano-convex, with two incurved horns at the upper angles, and opening by a narrow slit. It happens that the only specimens hitherto recorded with the gonosome sufficiently preserved for the sex to be ascertained are those of *S. inflata*, observed by Ritchie, which bore male gonophores, and those of *S. loculosa*, seen by Warren, in which the gonophores were female. Billard thereupon suggests that this may be a case of sexual dimorphism, the pinnate form being habitually associated with the male sex, and the unbranched form with the female. This view is not supported by any direct evidence, nor, so far as I am aware, is any analogous case known; I consider, therefore, that the pinnate and the simple forms should by no means be united until their affinities are actually proved. It may also be remarked that *S. inflata* is not always pinnate, though unbranched forms have not hitherto been referred to it; the *S. brevicyathus*, found by Versluys in the same dredging with his *S. inflata*, is almost certainly merely an unbranched form of the latter species; and in my own specimens, which agree absolutely with *S. inflata* (so far as can be ascertained in the absence of the gonosome), I find simple and pinnate shoots growing from the same hydrorhiza, or even, in one instance, the stem of a pinnate shoot running out into a stolon, which, in its turn, gives origin to an unbranched shoot. These simple forms differ from *S. loculosa* in the thinner perisarc, the more sharply triangular teeth, and the tendency (which is also exhibited by the pinnate form) for the ridge of the hydrotheca to become weaker, or sometimes quite obsolete, in the distal portions of the colony. But I doubt whether these distinctions are constant, and should not regard them as of specific value if the gonosome proved to be similar in each case.

S. brevicyathus is not distinguished from *S. inflata* except by the simple habit, and by points of structure known to be variable in the species of this group, such as the presence of a third tooth on the border of the hydrotheca.

Ritchie agrees with Congdon that the operculum of *S. inflata* has a large abcauline and two smaller latero-adcauline valves, but feels

assured that in *S. loculosa* (*turbinata* ?) the operculum is formed by a solitary flap. Probably the condition of the operculum would be determined by that of the hydrotheca-margin, which may or may not have the small superior tooth developed.

The species seems remarkably variable in size. The usual height is about half an inch, and according to Nutting often less, while specimens are recorded up to two inches. It is also said to vary greatly in the proportionate length of the internodes, as well as in the distinctness of the nodes. These in my specimens are all of the well-defined oblique type (sloping downwards from the back) so familiar in many Sertularians, and Ritchie describes his specimens as similar in this respect. Nutting, however, describes the nodes of the pinnae as straight, and Versluys says, "La partie distale de la pinnule est divisée plus ou moins distinctement en entrenœuds." The naked proximal part of the stem, which is divided from the hydrocladiate portion by a very marked joint, is much shorter in my specimens than in the type. I note the peculiarity mentioned by Allman and Ritchie of the pinnae falling off, leaving the basal portions as a series of pointed spines. Much variation exists in regard to robustness of texture, and to the distinctness of the transverse ridge.

Versluys first gave a satisfactory account of the species under the name of *Desmoscyphus inflatus* in 1899. Allman's *D. gracilis* was found by Nutting, from examination of type specimens, to be identical with Versluys' species, and as the name *S. gracilis* was preoccupied, Nutting re-named the species *S. versluysi*. Versluys' name, however, held priority till Billard later, on examining Allman's type, found that *S. amplectens* (1885) was also the same species. Afterwards Billard classed all these names, along with *S. flosculus* Thompson, *D. marginata* Kirchenpauer, and *S. loculosa* Busk, as synonyms of *S. turbinata* (Lamouroux). As I have for reasons already stated classed the two last-named species as at least provisionally distinct, I adopt for the pinnate form Kirchenpauer's name, *S. marginata*. Kirchenpauer's specimens, like my own, were without the gonosome. If, as is quite possible, our species should prove to have gonangia of a different type altogether, distinguishing it alike from *S. loculosa*, and from Versluys' species, it would be advisable to retain for it the name of *S. marginata*, and for the other form *S. amplectens*.

It may be noted that it is to the restricted *S. loculosa* that *S. marginata* exhibits, in the form of the hydrothecae, such close affinity. I have not seen it with the hydrothecae resembling those of *S. turbinata*.

Sertularia tenuis Bale.

Sertularia tenuis, Bale, Aust. Hydr. Zooph., 1884, p. 82, pl. v., figs. 4, 5, pl. xix., fig. 16; Jäderholm, Ark. f. Zool., k. svenska Vetenskapsakad, i., 1903, p. 287; (?) Thornely, Rep't. to Gov't. of Ceylon on the Pearl Oyster Fisheries of the Gulf of Manaar, Suppl. Rep't. viii., 1904, p. 117, pl. ii. fig. 5.

Sertularia gracilis (in part), Pictet, Rev. Suisse de Zool., i., 1893, p. 48.

Thuiaria tennis, Borradaile, Fauna and Geogr. of the Maldive and Laccadive Archipel., ii., 1905, p. 841.

Sertularia distans (in part), Billard, Arch. de Zool. Exp. et Gén., 4 sér., vii., 1907, p. 354; id., Expéd. Sci. du Travailleur et du Talisman, Hydroïdes, viii., 1907, p. 187, figs., 10, 11.

Not *Sertularia gracilis*, Hassall, Hincks, Brit. Hyd. Zooph., p. 262, pl. liii., fig. 2; Nutting, Amer. Hydr.—Sert., 1904, p. 57, pl. iii., fig. 10.

Not *Sertularia distans*, Allman, Gulf Stream Hydroids, 1877, p. 25, pl. xvi., figs 9, 10; Nutting (as *S. pourtalesi*), Amer. Hydr.—Sert., 1904, p. 59, pl. v., fig. 5.

Not *Dynamena distans*, Lamouroux, Hist. Polyp. Cor. Flex., 1816, p. 180. pl. v. fig. 1 a. b.

S. tenuis is mentioned here for the purpose of rectifying the synonymy, which has become confused owing to the association of the species with some others, which, however similar in the form of the hydrothecae, differ from it widely in other respects. Marktanner-Turneretscher first suggested its identity with a European form which he considered a variety of *S. gracilis*, and Pictet definitely stated that the two species were identical, overlooking the fact that the original description of *S. tenuis* was, in more than one point, obviously incompatible with the known characters of *S. gracilis*. In view of the same description it is difficult to imagine why Borradaile referred the species to the genus *Thuiaria*.

Billard accepted Pictet's statement, but having satisfied himself from his examination of Lamouroux' types that the *Dynamena distans* of that author was the same species as *S. gracilis*, ranked all these forms together, as well as the *S. distans* of Allman, and some other American species, which, however, Nutting considers distinct.

S. gracilis is a typical example of what Schneider calls the "*Dynamena*-group" of Sertularians; that is to say, it has the

hydrothecae in opposite pairs, and when branches are produced they spring from below (or sometimes above) one of the paired hydrothecae. Thus there is no difference in the arrangement of the hydrothecae on the stem and the branches, or as Nutting says we find "the stem and branches alike in every particular." This is obviously the simplest form of ramification possible, and is especially found among the *Diphasiae*. Now, from this arrangement *S. tenuis* differs entirely, and, so far as the ramification is concerned (though not otherwise), it agrees with Schneider's "*Thuiaria*-group," having each of the regular alternate pinnae springing from below an axillary unpaired hydrotheca, while the stem-internode supporting it supports also the normal pair, which in these circumstances are generally sub-alternate, the one on the same side as the pinna being set higher up. The arrangement is exactly the same as in *S. marginata* and numerous larger species, such as *S. elongata*, and by its differentiation of the stem and pinnae is of a more advanced type than that of *S. gracilis*. Besides the distinction between the three-celled internodes of the stem and the two-celled ones of the pinnae, there is the further difference that the hydrothecae of the stem are more divergent than those of the pinnae. Yet another distinction which has been overlooked is that *S. gracilis* has the nodes at distant and irregular intervals, while *S. tenuis* has them below every pair of hydrothecae (or every three hydrothecae in the case of the stem). Some species, however, are said to vary in this particular, and *S. tenuis* may possibly do so, but I have seen no instances, except in the special cases mentioned below.

While the pinnae, when present, are usually regular and alternate, the habit is not so firmly established as to preclude the occurrence of frequent irregularities. Thus it is not unusual to find the two lowest pinnae of a shoot on one internode and opposite (a condition, it may be remarked, which occasionally occurs in several other small alternately-branched species, both of *Sertularia* and *Plumularia*). The internode thus bears four hydrothecae, the two axillary ones and the regular pair, which are now opposite. Even on a pinnate stem there may be intercalated between two pinna-bearing internodes an internode supporting only a pair of hydrothecae. It is usual for the four or five internodes at the top of a pinnate stem to bear hydrothecae only, in which case this portion entirely resembles a pinna, the hydrothecae being opposite and becoming less divergent towards the summit. The simple shoots, which are the most numerous, have regular two-celled internodes, but the hydrothecae (except at the top) are widely divergent, like those

on the stems of the pinnate form, except that they are opposite and generally in contact in front. I have seen an abnormal case of a hydrotheca being transformed and continued as a branch. The hydrotheca-bearing portion of the pinna is separated from the cladophore by a short internode, exactly as in *S. marginata.*

The gonangia are pear-shaped, tapering below, not compressed, but circular in section, and with the outline towards the summit somewhat concave outwardly, thus differing from the "round-shouldered" compressed form found in certain species otherwise very closely allied to *S. tenuis.*

Sertularia divergens Busk.

Sertularia divergens, Busk, Voy. of Rattlesn., i., 1852, p. 392; Bale, Aust. Hyd. Zooph. 1884, p. 81, pl. v., fig. 3, pl. xix., fig. 16; Billard, Ann. Sci. Nat. 9 sér., ix., 1909, p. 322.

Not *Dynamena divergens*, Lamouroux, Hist. Polyp. Cor. Flex., p. 180, pl. v., fig. 2.

(?) Not *Sertularia moluccana*, Pictet, Rev. Suisse de Zool. i., 1893, p. 50, pl. ii., figs. 42, 43.

This species or variety differs from *S. tenuis* in the more compact habit, the shorter hydrothecae and internodes, and the closer pinnae, which are somewhat more divergent. The pinnate habit seems more confirmed; indeed, I have not yet observed any of the unbranched shoots which in *S. tenuis* predominate, though such will doubtless occur.

Pictet considered his *S. moluccana* a variety of this species, but he renamed it because he regarded it as distinct from Lamouroux' species. I do not think *S. moluccana* is the same, judging by Pictet's figure. He mentions that the ramification agrees with my description, but the ramification is common to many other species.

The investigations of Billard confirm the opinion expressed by Pictet, and earlier by myself, that this is not the *D. divergens* of Lamouroux, but as that species is the same as *S. bicuspidata*, Lamarck, which name Billard has adopted, the name may stand as *S. divergens*, Busk, unless it be treated, as Billard with much reason proposes, as a mere variety of *S. tenuis.*

Sertularia acanthostoma Bale.

Sertularia acanthostoma, Bale, Journ. Micr. Soc. Vict., ii., 1881, p. 23, pl. xii., fig. 4; id., Aust. Hydr. Zooph., 1884, p. 85, pl. iv., fig. 7, 8; Billard, Arch. d. Zool.

Exp., 4 sér., vii., 1907, p. 352; Bartlett, Geelong Naturalist, 2 ser., iii., 1907, p. 44, fig. —; Warren, Ann. Nat. Gov't. Museum, i., 1908, p. 303, fig. 7, pl. xlvi., figs. 23-26.

Billard has pointed out that in this species there are not always three pairs of hydrothecae between every two pairs of pinnae, as stated in the original description, but that the number varies, three, however, being the rule. I have noticed a similar irregularity in a Portland specimen given to me by Mr. Maplestone, which has four pairs in some of the intervals, thus agreeing with the majority of cases in which Billard found a departure from the typical number. I have also met with a specimen in which the stem, consisting of thirteen internodes, was unbranched throughout.

Warren mentions that his Natal specimens were usually covered with a delicate algal incrustation. This organism is also very commonly found on Australian specimens.

S. pluridentata (Kirchenpauer), another African species, is remarkably similar to the present in the general form of the hydrothecae. The pinnae, however, are not opposite, but, according to Kirchenpauer, irregular. The denticulation of the hydrotheca-border appears to agree with that of *S. acanthostoma* in so far that it is symmetrical on the two sides of the hydrotheca, but the teeth differ both in number and arrangement, *S. acanthostoma* having sixteen, while *S. pluridentata* has only eight. These eight are arranged precisely like those of many Statoplean Plumularians; that is to say, there is a median unpaired tooth on the adcauline extremity of the border, and a similar one on the apocauline margin, while each of the intermediate sides supports three teeth, thus making two unpaired teeth and three pairs. In *S. acanthostoma* there are no median teeth on either the adcauline or the apocauline margins, but the teeth are arranged in eight symmetrical pairs on the two sides. Warren's figure of the hydrotheca, seen from above, presents a quite striking resemblance to the front view of *Halicornaria ilicistoma*, in which also the teeth are arranged, some pointing inward and others outward.

Dr. Warren has furnished interesting details of the structure, pointing out especially that in the concave depression at the outer margin of the hydrotheca there is a thickening of the ectodermal epithelium, which has very much the character of a nematophore, being provided with a battery of large nematocysts similar to those found in the Plumularians. He also remarks that the hydrotheca is distinguished by possessing no trace of operculum.

The gonothecae have only been observed by Bartlett. They are described as "long, obovate, smooth, aperture operculate." They are of unusually long proportions, widest a little above the middle and but little narrowed above; the operculate aperture seems to be the full width of the top, and no collar is shown. The height, according to Bartlett's figure, is about 2 mm., by 1 mm. in diameter.

Sertularia muelleri, n. sp. (Plate XII., Figs. 1–5.)

Shoots thickly clustered, simple, nearly half an inch in height, slender, divided by conspicuous oblique joints into internodes, each of which supports a pair of hydrothecae about the middle.

Hydrothecae opposite, in contact in front, separated behind, tubular, divergent, but with the distal part curved upward; aperture very large, looking upward, with two long pointed teeth, one in front, the other, which is slightly larger, on the back outer margin.

Gonothecae borne on the proximal part of the shoots, mostly 2-4 on each; ovate, somewhat compressed, very high-shouldered; orifice small, operculate, with a narrow denticulate collar.

Hab.—Encounter Bay.

This species has some affinity with *S. minima*, but the internodes are considerably longer and more attenuated, the hydrothecae have the aperture more expanded, looking more upward and with longer teeth, and there is a characteristic curve upward of the outer side of the hydrotheca at the top. To a certain extent they resemble the hydrothecae of *S. operculata*. The gonangia are of the same general type as those of *S. minima*, but rather irregular, many of them having the shoulders very high and somewhat angular. The shoots are produced in great profusion, a slender linear alga ten inches long, being thickly clothed with them from end to end.

The specimen was given to me by the late Baron von Mueller.

Plumularia campanula Busk.

Plumularia campanula, Busk, Voy. of Rattlesn., i., 1852, p. 401; Bale, Aust. Hydr. Zooph., 1884, p. 124, pl. x., fig. 5; id., Proc. Lin. Soc. N.S.W., Ser. 2, iii., 1888, p. 776, pl. xx., figs. 1-6; id., Tr. and Proc. Roy. Soc. Vict., xxiii., 1887, p. 94; id., Proc. Roy. Soc. Victoria, vi., N.S., 1893, p. 113; Marktanner-Turneretscher, Ann. d. k. k. Naturh. Hofmuseums, v., 1890, p. 255; Farquhar, Trans. N.Z. Inst., xxviii., 1896, p. 466; Billard, C. R. Acad. d. Sci., cxlvii., 1908, p. 759.

Plumularia indivisa, Bale, Journ. Micr. Soc. Vict., ii., 1881, p. 39, 46, pl. xv., fig. 1.

Plumularia laxa, Allman, Chall. Plum. 1883, p. 19, pl. i., figs. 5, 6.

Plumularia torresia, Von Lendenfeld. Proc. Lin. Soc. N.S.W., ix., 1884, p. 477, pl. xiii., figs. 13, 14, pl. xiv., fig. 16.

Plumularia rubra, Von Lendenfeld, Proc. Lin. Soc. N.S.W., ix., 1884, p. 476, pl. xiii., figs. 11, 12, pl. xiv., fig. 15.

The simple form of this species was described by me in 1881 under the name of *P. indivisa*, but it was mentioned in an addendum that it had been found to be identical with the stemless form described by Busk. It is introduced here for the purpose of rectifying its erroneous association by several writers with the widely-distributed *P. secundaria*, consequent on Dr. Billard's report that Busk's type specimen in the British Museum was the same as that species. This statement is doubtless correct, being confirmed in letters from both Dr. Billard and Dr. Kirkpatrick, nevertheless Busk's account shows clearly that the specimens which he had before him were not *P. secundaria;* moreover, my specimens agree precisely with those described by Busk. Obviously this is an instance, like others I have met with, in which the museum specimen is erroneously labelled; and in this case the confusion is not surprising, as the two forms cannot be distinguished from each other without microscopical examination, and, as I have now ascertained, both are found in the same locality.

Under the microscope the two hydroids are easily distinguished. The short, stout, rigid or semi-rigid lateral sarcothecae of *P. campanula* and its stemless variety, are in themselves sufficient to mark it as distinct from any species with the long, wine-glass-shaped cups found in *P. secundaria*, *P. catharina*, etc., as Busk points out. Other differences are the presence in *P. secundaria* of a very small sarcotheca behind the hydrotheca, not found in *P. campanula*, and also the presence of one, two, or three, but generally two, median sarcothecae on the upper part of each internode, where *P. campanula* has only one.

The ramification of *P. campanula* is very variable. First we have the *indivisa*-form, in which simple hydrocladia spring directly from the hydrorhiza. Among these we find shoots which give origin to one, or perhaps two, secondary hydrocladia. From these the transition is easy to regularly pinnate forms, such as constitute the *P. rubra* of Von Lendenfeld; and thence to the polysiphonic

branched form described by Von Lendenfeld as *P. torresia*, and by Allmann as *P. laxa*. These forms also frequently bear additional hydrocladia springing at irregular intervals from the regular pinnately-disposed series.

Plumularia badia Kirchenpauer.

Plumularia badia, Kirchenpauer, Abh. Nat. Ver. Hamb., vi., 1876, p. 45, pl. i., iv., fig. 3; Bale, Catal. Aust. Hyd. Zooph., 1884, p. 128, pl. xviii., figs. 1-2.

Plumularia ramsayi, Bale, Cat. Aust. Hydr. Zooph., 1884, p. 131, pl. xi., figs. 3, 4; id., Proc. Lin. Soc. N.S.W., Ser. 2, iii., 1888, p. 746; Kirkpatrick, Sci. Proc. Roy. Dubl. Soc., vi., (N.S.), 1890, p. 604.

Plumularia gracilis, Von Lendenfeld, Proc. Lin. Soc. N.S.W., ix., 1884, p. 476, pl. xiv., fig. 17, pl. xvii., figs. 28, 29.

Dr. Hartlaub has kindly examined, at my request, the type specimens of Kirchenpauer's *P. badia*, and has found them to be, as I suspected, identical with *P. ramsayi*. The point into which the anterior lip of the hydrotheca is, according to Kirchenpauer, produced, is not really present, neither are the other features by which the species appeared to be distinguished from *P. ramsayi*. So far from being produced as shown, the front of the hydrotheca is really somewhat everted, though very slightly.

Aglaophenia brevirostris (Busk). (Plate XIII., Figs. 7, 9.)

Plumularia brevirostris, Busk, Voy. of Rattlesn., i., 1852 p. 397.

Aglaophenia brevirostris, Bale, Aust. Hyd. Zooph., 1884, p. 169; Kirkpatrick, Sci. Proc. Roy. Dubl. Soc. vi. (N.S.), 1890, p. 611; Billard, C. R. Acad. d. Sci., cxlviii., 1909, p. 368.

Thecocarpus brevirostris, Billard, Ann. Sci. Nat., 9 ser., xi., 1910, p. 51, fig. 24.

Aglaophenia heterocarpa, Bale, Journ. Micr. Soc. Vict., ii., 1881, p. 30 (note).

Aglaophenia vitiana, Bale, Aust. Hydr. Zooph., 1884, p. 152.

Aglaophenia maldivensis, Borradaile, Fauna and Geogr. of the Mald. and Laccad. Archip., ii., 1905, p. 843, pl. lxix., figs. 8-8b.

Not *Plumularia* (for *Aglaophenia*) *vitiana*, Kirchenpauer, Abh. Nat. Ver. Hamb., v., 1872, p. 34, pl. i. iii., fig. 9; Billard, Arch. Zool. Exp. et Gén., 4 Sér., vii., 1907, p. 388, figs. 22, 23.

Hydrophyton about one inch in height, polysiphonic in the older portions only, and small specimens monosiphonic throughout; branched or unbranched, branches when present all in one plane, given off at very wide angles from the supplementary tubes; internodes normally supporting each a hydrocladium, but the nodes often indistinct. Hydrocladia straight, alternate, divergent at a wide angle (about 65 deg.) in one plane, nodes transverse, dorsum of hydrocladia slightly serrate.

Hydrothecae borne on the front of the hydrocladia, tubular, more or less abruptly bent in the middle (proximal and distal extremities being bent away from the hydrocladium); a rudimentary ridge or fold near the base, directed obliquely forward; aperture expanding, border with a large strongly-incurved anterior tooth, two large triangular teeth on each side, and two angular lobes above the lateral sarcothecae; back entire, adnate. A very slight septal ridge generally present, opposite the intrathecal fold.

Mesial sarcothecae free for about half their length, embracing the whole of the proximal part of the hydrotheca, and then projecting forward over the aperture; with a small circular terminal orifice and a larger inferior one adjoining the hydrotheca, the two united by an inconspicuous slit; an additional orifice opening into the hydrotheca. Lateral sarcothecae small, sub-conical, directed forward or downward and somewhat outward, terminal and lateral apertures generally united. Cauline sarcothecae with wide, free distal margin, two at the base of each hydrocladium. A minute apparent perforation on each hydrocladium-process.

Gonangial ramules with a normal hydrotheca on the first internode; corbula consisting of about five pairs of leaflets with lobed edges, which are united by the lobes, leaving a series of small openings between them; rows of sarcothecae very irregularly placed, those nearest the rachis mostly bordering the distal edges of the leaflets, but those higher up in short rows, not at the edges; each leaflet with a large sinus near the base on the distal side, in which is seated a small hydrotheca with its two lateral sarcothecae. Rachis generally produced beyond the corbula, its terminal portion supporting about two somewhat modified hydrothecae.

Colour, light brown.

Hab.—Fiji, on a coral: off Cumberland Ids., 27 fathoms (Busk): Torres Strait (Haddon): on the reef at Hulule, Male Atoll (Borradaile).

Busk's original description of *P. brevirostris* was insufficient to admit of its identification, but Dr. Kirkpatrick kindly compared one of my specimens with Busk's type, and has also sent me a specimen from Haddon's Torres Strait collection, which proves similar in all respects to my own specimens from Fiji. These I described in 1881 under the proposed name of *A. heterocarpa*, but I afterwards referred them to the *A. vitiana* of Kirchenpauer ("Catalogue," p. 152). The later descriptions by Billard of both *A. vitiana* and *A. brevirostris* seem to prove, however, that this reference was erroneous.

Nevertheless, the two species have many points of agreement. Both were found growing on a coral from Fiji; in size, habit, and colour they agree closely, as well as in some minor particulars. The branches in each species spring from the supplementary tubes, so that branching cannot occur till the polysiphonic structure is developed, which in many cases is not till growth is well advanced. One of my specimens of *A. brevirostris* consists of a single shoot bearing five corbulae, but with no trace of fasciculation. The proximal part of the stem is naked at first, then supporting a few large sarcothecae in a single row before the hydrocladia are reached.

The principal distinction between the hydrothecae of the two species is that in *A. vitiana* there is an anterior intrathecal ridge similar to that of *Lytocarpus phillipinus*, while in *A. brevirostris* the distal part of the hydrotheca, though abruptly recurved, does not become united to the proximal portion, so that instead of an intrathecal ridge there is on the apocauline side of the hydrotheca a deep constriction. In *A. vitiana* the two principal teeth on each side of the hydrotheca are said to be bifid, and the internode is described as having three septal ridges, or sometimes only two. *A. brevirostris* has the lateral teeth simply triangular, and there is scarcely ever more than one septal ridge, which subtends the inthrathecal fold. In *A. vitiana* the internodes are stouter, as is the mesial sarcotheca, and the canaliculate condition of the latter is more apparent.

Both Billard's and Borradaile's figures show the constriction of the hydrotheca as much less abrupt than is usually the case. In Haddon's specimen, as well as in my own, such hydrothecae are abundant, but in both cases the majority are of the more abruptly bent type.

A singular condition noted by Billard as occurring in *A. vitiana* and *Idia pristis* is observable also in *A. brevirostris*, namely, the reversal of the front and back of the polypidom. I have once observed the same thing in *A. sinuosa*, but it would seem to be a common occurrence in *A. brevirostris*, as it is found in more than one of my few specimens. In one instance a branch has the hydrocladia up to about the middle all fronting one way, suddenly a reversal occurs, and the hydrocladia face in the opposite direction; this continues for a distance including four hydrocladia on each side, and then a second reversal takes place, and on the rest of the branch the hydrocladia face as at the beginning. In another case the part of the shoot including the first five hydrocladia faces one way, and the remainder in the opposite direction. Billard found that these reversals followed a regeneration of a broken part; in my specimens, however, this did not appear to be the cause, as I could find not the slightest breach of continuity in the branches.

The corbulae of *A. brevirostris* are interesting structures, combining, as I pointed out in 1881, the general character of the *A. pluma* type with the presence of hydrothecae on the leaflets. The attachment of the leaflets to each other by the marginal lobes, leaving small interstices between, is a feature found also in the corbulae of *A. macrocarpa*. Another noteworthy feature is the continuation of the gonocladium beyond the corbula, where it resumes for a short distance the character of a hydrocladium, supporting one or two hydrothecae.

Lytocarpus auritus (Busk). (Plate XIII., Fig. 10).

Plumularia aurita, Busk, Voy. of Rattlesn., i., 1852, p. 397.

Aglaophenia aurita, Bale, Aust. Hydr. Zooph., 1884, p. 169, pl. xviii., figs. 18, 19.

Lytocarpus phœniceus auritus, Billard, C. R. Acad. d. Sci., cxlviii., 1909, p. 367; id., Ann. d. Sci. Nat., 9 sér., xi., 1910, p. 49.

Aglaophenia disjuncta, Pictet, Rev. Suisse de Zool., i., 1893, p. 59, pl. iii., figs. 51, 52.

Hydrophyton 2-3 inches in height, polysiphonic in the older portions only, and small specimens monosiphonic throughout, branched or unbranched; branches when present all in one plane, given off almost at right angles from the supplementary tubes, each internode normally supporting a hydrocladium, but the nodes often indistinct. Hydrocladia straight, alternate, divergent at a wide

angle (about 75 deg. to 80 deg.), and a little directed towards the front; nodes transverse or scarcely oblique, indistinct.

Hydrothecae borne towards the front of the hydrocladia, with which their longest diameter is parallel, a slight constriction near the base on the adcauline side, continued into a slight transverse fold; an anterior intrathecal ridge projecting downwards from between the front of the aperture and the mesial sarcotheca more than half-way through the cell; aperture at a small angle with the hydrocladium, sub-crenate, sub-plicate, each side forming an angular lobe, front entire, a rounded lobe or an erect tooth behind. Hydrothecal internode with two divergent septal ridges, one nearly opposite the rudimentary posterior ridge, the other at the base of the lateral sarcothecae; generally a third midway between them.

Mesial sarcotheca adnate to the front of the hydrotheca nearly as far as the aperture and mainly rising from it, free part variable in length, slightly tapering, projecting forward at a varying angle, with distinct terminal and inferior apertures and a small orifice opening into the hydrotheca. Lateral sarcothecae conical or tubular, either adnate and directed upwards, or large, free and projecting downwards from the hydrotheca; terminal and lateral apertures distinct. Cauline sarcothecae similar to the laterals, but wider, two at the base of each hydrocladium.

Gonosome?

Colour, bright brown.

Hab.—Port Darwin Telegraph Cable: off Cumberland Island, 27 fathoms (Busk): Bay of Amboyna, 80 metres (*A. disjuncta*, Pictet).

This species, like *A. brevirostris*, was insufficiently described by Busk, and remained unidentified until 1909, when Billard examined Busk's type in the British Museum, and found its structure to agree with that of *L. phœniceus*. But the habit is different; Busk says that the branches are at right angles to the stem, and that the habit closely resembles that of *A. brevirostris* (where the hydrocladia also form a wide angle with the rachis), while in all the varieties of *L. phœniceus* observed by me the branches, and also the hydrocladia, are set at angles of about 45 deg. *L. auritus* may therefore be described as having the habit of *A. brevirostris* with the minute structure of *L. phœniceus*, and this description applies to a small specimen which, I have had for many years, but which I had always hesitated to assign to *L. phœniceus* (notwithstanding the similarity of the hydrothecae), on account of the different habit. It was still in the monosiphonic stage, and, therefore, unbranched, and was collected from the Port Darwin cable, where it was growing

in company with fertile specimens of *L. phœniceus*. That the type specimen is similar is evident from the statement of Dr. Kirkpatrick, who writes, "*A. aurita* seems to me to be a variety of *A. phœnicea*. The hydrothecae are identical, but the hydrocladia more separated and at a wider angle."

I have a sketch by Mr. Busk, showing the ramification only. It represents a colony an inch and a half high, which divides just above the base into three ascending stems, each of which gives origin to two or three branches on each side, the branches being, as Busk describes, "not opposite nor regularly alternate, divaricate at right angles." (The "right-angled" condition is only approximate). Pictet's figure of his *A. disjuncta* agrees perfectly with Busk's account and sketch.

As to the form of the hydrotheca Billard finds that Busk's specimen resembles most closely the form of *L. phœniceus* figured by me on plate xv., fig. 5, of the "Catalogue," but with the median tooth less developed. My specimen differs from this in having the crenation or plication of the hydrotheca-margin much feebler, also in having the lateral sarcothecae of the erect type, while those of the figure cited are directed downward. Some at least of Busk's specimens must have agreed with mine, since he describes the lateral sarcothecae as rising above the hydrotheca. Pictet's specimen also agrees in this particular, as well as in the feeble plication of the hydrotheca-margin. It seems, therefore, that the wide range of variation found in the hydrothecae of *L. phœniceus* is paralleled in *L. auritus*, and that Billard's suggestion to establish *auritus* as a variety based on a particular form of hydrotheca will scarcely be applicable. The variety or species should be founded on the peculiar habit, by which *L. auritus* is distinguished from all the forms of *L. phœniceus*.

Pictet's description and figure of his *A. disjuncta* agree so closely with *L. auritus* that I think there can be little doubt of their identity. The only points in which a distinction is indicated are the position of the hydrocladia in the same plane, and of the hydrothecae, which are said to face the front exactly. Both these descriptions as applied to my specimen are only approximately correct, but the differences are negligeable. The distance apart of the hydrothecae, which is the feature regarded by Pictet as of principal importance, is not greater than in one or two forms of *L. phœniceus* in my possession.

HALICORNARIA ARCUATA (Lamouroux). (Plate XIII., Figs. 1-4).

Aglaophenia arcuata, Lamouroux, Hist. Polyp. Cor. Flex., 1816, p. 167, pl. iv., fig. 4a, b; Kirchenpauer, Abh. Nat. Ver. Hamb., v., 1872, p. 27, pl. i., fig. 10.

Plumularia arcuata, Lamarck, An. s. Vert. 2nd Ed. ii., 1836, p. 166.

Aglaophenia arquata, Krauss, Coral. u. Zooph. d. Sudsee, 1837, p. 24.

Halicornaria arcuata (in part), Billard, Arch. d. Zool. Exp., 4 sér., vii., 1907, p. 366, fig. 13; Stechow, Zool. Jahrb., xxxii., 1912, p. 369.

Halicornaria cornuta, Allman, Journ. Lin. Soc. Lond., Zool., xix., 1886, p. 153, pl. xxiii., figs. 1-4.

Hydrocaulus monosiphonic, unbranched or dividing dichotomously one or more times; hydrocladia alternate, one on each internode, set at an angle of about 45 deg. to 50 deg., and slightly directed forward; nodes slightly oblique.

Hydrothecae cup-shaped, deep and narrow, set at a wide angle (about 75 deg. to 80 deg.), no true intrathecal ridge, but the apocauline wall somewhat incurved at the point where it is interrupted by the hydropore, which is large and distinct; aperture with a strong median anterior incurved tooth and usually with three teeth on each side, of which the first and third are large and everted, while the middle one is small and incurved, the latter often more or less obsolescent or totally wanting; back produced upward into a long erect lobe with the edges curved towards each other on the outer side, hydropore with one or two minute denticles above and below. No septal ridges in the internode.

Mesial sarcotheca quite erect in the proximal portion, distal half directed forward, either parallel with the hydrocladium or more obliquely; free part compressed laterally, very stout at the part just above the hydrotheca, where the strongly salient aperture is situated, terminal portion tapering very rapidly to the acute closed point. Lateral sarcothecae adnate, saccate, with two small circular apertures close to the free margin, the lower one becoming, in those near the end of the hydrocladium, produced into a large tubular mouth, or even into a long closed pointed horn, having its own lateral aperture, while the upper circular orifice becomes obsolete. Cauline sarcothecae similar to the laterals, two, close together, at the base of each hydrocladium in front, and one at the back of each axil.

Gonosome?

Colour, brown ("fauve brillant et foncé"—Lamouroux).

Hab.—Mer des Antilles (Lamouroux): Algoa Bay and Algiers (Krauss): Fort Dauphin, Madagascar (Billard): Cape of Good Hope (Kirchenpauer).

This African species, which is not known to occur in Australia, is introduced here on account of Billard's having referred to it our *H. ascidioides*, which indeed singularly resembles it in several particulars, but which, as I shall show, is nevertheless quite distinct.

The form which is described above (from specimens obligingly forwarded to me by Dr. Stechow from the Munich Museum) is, I have no doubt, the true *Aglaophenia arcuata* of Lamouroux and Kirchenpauer (also the *Halicornaria cornuta* of Allman), but Billard includes with it several forms which he considers to be the young colonies, and which, if really to be referred to the same species, stamp it as variable to an extent unknown elsewhere in the order. I have not seen these forms, some of which appear scarcely to differ from our *H. longirostris*, and the specimens sent to me, which include young colonies of only two centimetres in height and mature ones of eleven or twelve, do not differ noticeably among themselves. When the mesial sarcotheca is carried forward parallel with the hydrocladium they agree roughly with Lamouroux' figure, when it is more oblique they approximate to Kirchenpauer's.

According to Lamouroux' figure the hydrocaulus is dichotomously divided several times, but from Billard's account the ramification is peculiar and probably unique; a branch springs from the front of the hydrocaulus, and has its anterior aspect directed towards that of the stem, and each successive branch grows in the same manner. The result of this mode of branching appears to be that all the branches are in one plane, but in a plane at right angles to that of the hydrocladia. This may be contrasted with the condition which prevails in *H. furcata* and its allies, where the hydrocaulus bifurcates in a single plane, which is also the plane of the hydrocladia. According to Lamouroux' figure the branches diverge at a very wide angle (about 90 deg.).

Billard states that in young colonies the cauline internodes are longer than wide, and nearly cylindrical, while in mature colonies the side of the internode on which the hydrocladium is borne is about double the length of the opposite side. The latter description applies to all my specimens, young and old, except that the difference in length of the two sides is not so great. The internodes are

very short, and the one side being longer than the other it follows that the nodes are oblique, alternately sloping to the right and the left, so that the internode, as seen from the back or the front, appears cuneate.

Billard's description of the hydrothecae in mature colonies is as follows:—"Enfin dans les colonies âgées la région proximale et moyenne des hydroclades montre des hydrothèques dont le bord présente trois dents latérales, la première et la troisième étant rejetées vers l'extérieur, et la dent moyenne dirigée vers l'intérieur; dans la partie distale la dent moyenne qui se réduit au fur et à mesure qu'on s'élève a disparu complètement et il n'existe plus que deux dents latérales; de plus les dactylothèques latérales sont trés allongées et atteignent jusqu'à 160μ. On a ainsi un dessin qui concorde en tous points avec celui donné par Allman pour son espèce *Halicornaria cornuta*, et celle-ci ne se distingue pas de l'espèce de Lamouroux.

"Les hydrothèques de ces colonies agées montrent une dent postérieure extrêmement développée; parfois elles possèdent un repli intrathécal; la présence de cette particularité permet de faire entrer en synonymie l'*Halicornaria ascidioides* Bale, qui possède les mêmes caractères. Les dactylothèques médianes sont plus fortes dans ces colonies âgées, elles sont ouvertes ou bien parfois fermées à leur extrémité et il en est de même des dactylothèques latérales allongées."

The foregoing extract describes my specimens (both young and old) exactly, with these exceptions—the lateral sarcothecae are not usually so much elongated as described, the mesial sarcothecae are in no case open at the ends, and there is no intrathecal ridge, at least not such as *H. ascidioides* possesses, as will be presently explained.

Billard says that the gonosome is unknown. Krauss, however, mentions it in the following terms:—"Junge Exemplare haben eben so einseitig in den Achseln der Fiederchen sitzende grössere weibliche Zellen (sogenannte Bläschen). Am Strande ausgeworfen, verliert diese Aglaophenia bald ihre Fiederchen, während ein Theil der weiblichen Zellen hängen bleibt und erhält dadurch ein so verändertes Ansehen, dass Mann eine ganz andere Art vor sich zu haben glaubt." Unfortunately no description of these gonangia is given.

In comparing this species with *H. ascidioides* I may premise that I am unable to find a branched specimen of the latter, though I am under the impression that I have seen one. It is so extremely

close an ally of *H. superba* that there is every probability that its ramification would be similar; that is to say, a true branching, not a dichotomous division. A definite distinction is seen in the arrangement of the hydrocladia; those of *H. arcuata* are borne each on a separate internode, and are consequently always alternate, while in *H. ascidioides* every internode bears two hydrocladia, which are always opposite or nearly so. The hydrothecae of *H. arcuata* differ in form from those of *H. ascidioides*, being narrower towards the base, and are more erect, the central axis of the latter being at about 60 deg. to the internode, while that of the former is about 80 deg., the anterior side being indeed almost or quite at a right angle. The hydropore in *H. arcuata* is more conspicuous than in most species, owing to the perisarc being thickened up to the edge of the pore, so that the abrupt interruption is very noticeable in optical section. The slight ridge or projection inside the apocauline wall of the hydrotheca is caused by this thickened edge being more or less incurved just where it borders the hydropore on the upper side, and is therefore not analogous to the intrathecal ridge in *H. ascidioides* (and all the members of its group), which is a distinct septum, springing from the wall of the hydrotheca and projecting half across its cavity, and which does not border the hydropore but is situated some distance above it. Such a ridge is truly "intrathecal," while the ridge in *H. arcuata* is not *within* the hydrotheca at all, but is merely a portion of its boundary. At the same time there is no doubt that this rudimentary ridge indicates how the fully-developed ridge of such species as *H. ascidioides* has originated. The inflection of the hydrotheca-wall has been extended till it reached half across the cell, and then the inflected portions have been brought into contact and united. But this extension could not occur in a form like *H. arcuata*, unless the hydropore were removed away from the ridge to a lower position, as in the other species. While in most members of the genus the hydropore is much less conspicuous than in *H. arcuata*, its whereabouts is easily discernible (where the specimen is clean) by the little points of perisarc which project from its upper and lower margins. These denticles are a character which I have found common to all the species of *Halicornaria* which I have yet observed. In *H. arcuata* they are less conspicuous than in most species, but one or two can generally be made out, at least on the upper border of the hydropore, which, in this species, is the "ridge."

In regard to the hydrotheca-margin the two species differ notably. Both have an anterior tooth and one on the back, but the latter in

H. arcuata is much larger and has the edges turned outwards and recurved till it often appears quite tubular. The lateral teeth, however, are the most distinctive. There are normally three on each side; in *H. ascidioides* the middle one is always the largest (or at least as large as either of the others), and is always more or less everted, as are also the first and third. In *H. arcuata*, on the contrary, the middle tooth is the smallest, and is incurved, while the first and third are everted. In both species the lateral teeth may be reduced to two on each side, but in *H. arcuata* this results from the gradual disappearance of the incurved middle tooth, in *H. ascidioides* it is always the third tooth which becomes obsolete. In all the Australian species of the *ascidioides*-group the rule holds good that the middle lateral tooth is the principal one; in some cases the first may become obsolete, in others the third, and in others again both the first and third, but the middle one is in every species well developed, and always everted. The obsolescence of the middle tooth in *H. arcuata* becomes more pronounced towards the ends of the hydrocladia, but I do not find this to be the case with the decrease of the third tooth in *H. ascidioides*, the hydrothecae near the ends often having the teeth best developed.

The mesial sarcothecae of *H. arcuata* differ from those of *H. ascidioides* by the more erect proximal portion, the much more pronounced tapering of the free portion, and the closed pointed ends. I have never seen the ends closed in *H. ascidioides*, except in certain deformed specimens, where they were bluntly rounded. The lateral sarcothecae of *H. ascidioides* are never, so far as I have seen, prolonged into long closed horns as in *H. arcuata*, though as in many other species the tubular mouth is considerably elongated towards the ends of the hydrocladia. Only on the proximal part of the hydrocladia in *H. arcuata* are the little circular orifices equally developed, the lower ones become progressively more and more prominent towards the ends of the hydrocladia, where they attain the condition of rather long open tubes, or even pointed horns. In either case they have a lateral orifice on the inner side, and the upper of the two circular orifices has disappeared.

I have figured *H. ascidioides* along with *H. arcuata* for comparison. (See plate XIII).

Halicornaria superba Bale.

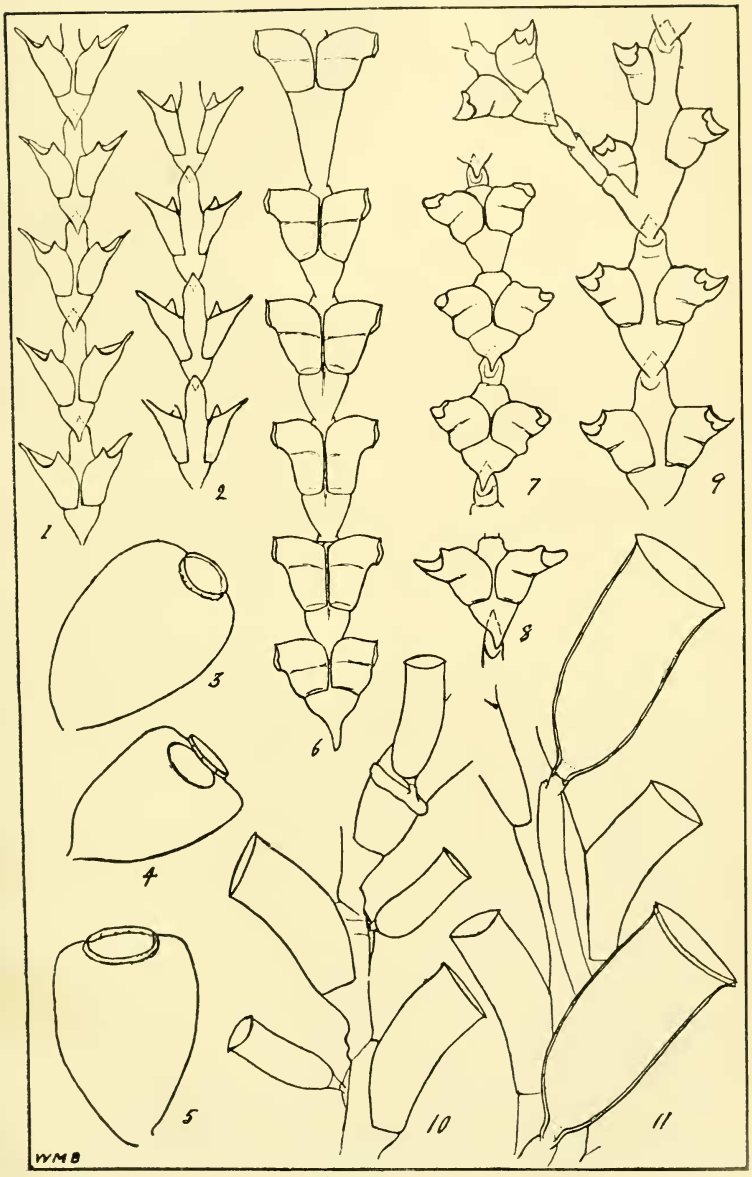
Aglaophenia superba, Bale, Journ. Micr. Soc. Vict., ii., 1881, p. 31, 45, pl. xiii., fig. 4-4b.

Halicornaria superba, Bale, Aust. Hydr. Zooph., 1884, p. 175, pl. xiii., fig. 1, pl. xvi., fig. 4; id., Proc. Roy. Soc. Vict., vi., N.S., 1893, p. 107.

I mention this species for the purpose of describing its mode of branching, and, incidentally, of contrasting it with the very different ramification of other members of the same section. The six or seven species in question form a very natural group, distinguished from all our other species (except *H. birostrata*) by the possession of a strongly-developed anterior ridge, and from all our other Statoplea by the position of that ridge. The minor characteristics of this group enable us to divide it into three sub-groups, the first consisting of *H. ascidioides* and *H. superba*, which are very intimately allied; the second of *H. baileyi*, *H. furcata*, and *H. intermedia*, which approximate even more closely; and the third of *H. hians* and *H. haswellii*, which also are nearly akin.

I have not seen either of the two last-named species in a branched condition, and though I believe I have seen a branched specimen of *H. ascidioides*, I cannot find one for reference. I have, however, several such specimens of *H. superba*, the ramification of which is quite different from that of *H. baileyi* and its two allies. In these latter there are strictly speaking no *branches*, every subdivision being purely dichotomous (resulting in general from the bifurcation of a single internode); the two new divisions are of equal diameter, each diverges at about the same angle from the primary axial line, and the perisarc is not interrupted at the bifurcation, but continuous, and even the regular spacing of the hydrocladia along the outer sides of the hydrocaulus is not interfered with.

H. superba is generally unbranched, but here and there among a large cluster is found a shoot giving off a small branch, or some times two, and in one case I found three. In many instances these branches sprang from the lower part of the stem, where it was denuded of hydrocladia, and were themselves bare on the proximal portion. There is no dichotomous arrangement, but a perfect distinction is maintained between stem and branches, the latter being smaller, and divergent abruptly from the side of the stem; indeed, they mostly start out at a right angle, though very soon curving upwards. The perisarc in their proximal portion is divided into internodes, much more strongly marked than the internodes of the hydrocladiate portions, and without hydrocladia, thus agreeing with the structure of the branches in the Statoplea generally, which is, in fact, simply a repetition of the primary structure of the proximal part of the stem itself. On a specimen which I examined one branch commenced with an exceedingly short discoid internode, unarmed; the next was longer, cylindrical, with a large sarcotheca in the middle; then followed five longer internodes, each of which



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